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Adoption of Ride-hailing in California and Impacts on the Use of Other Travel Modes

November 28, 2017

Dr. Giovanni Circella

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UCDAVIS
INSTITUTE OF TRANSPORTATION STUDIES

3 REVOLUTIONS
SHARED · AUTOMATED · ELECTRIC

3 Revolutions Future Mobility Program

3 REVOLUTIONS
SHARED · AUTOMATED · ELECTRIC

Disruptive technologies such as **shared mobility**, **electrification** and **autonomous vehicles** are bringing big changes in:

- *Transportation supply*
- *Transportation demand*

Need for rigorous research and impartial policy analysis to understand the impacts of these revolutions, and guide industry investments and government decision-making.

11TH HOUR PROJECT
THE SCHMIDT FAMILY FOUNDATION

PISCES FOUNDATION

ClimateWorks

National Center for Sustainable Transportation

ENERGY FOUNDATION
building a new energy future

3 Revolutions Future Mobility Program

Research activities of the 3 Revolutions Future Mobility Program include:

- ***Data collection and analysis*** *of behavioral and attitudinal data on shared mobility, adoption of electric vehicles and of connected/automated vehicles;*
- ***Forecasting and simulation models*** *of the impacts on activity participation, travel patterns, vehicle ownership, and vehicle miles traveled;*
- ***Behavioral experiments*** *to understand the impacts of the adoption of new transportation technologies;*
- ***Policy analysis*** *and simulation of future transportation scenarios; and*
- ***Analysis of environmental, economic and equity impacts*** *of emerging transportation trends and evolving lifestyles.*

RESEARCH QUESTIONS

Research Questions

- What factors drive the use of ridehailing?
- Under which circumstances individuals are more likely to use Uber/Lyft?
- How frequently do Californians use ridehailing?
- How do sociodemographics, the built environment, lifestyles and personal preferences affect the frequency of use?
- What limits/encourages the use of these services?

Research Questions (2)

How does the adoption of *shared mobility* affect other components of *travel behavior* and *vehicle ownership*?

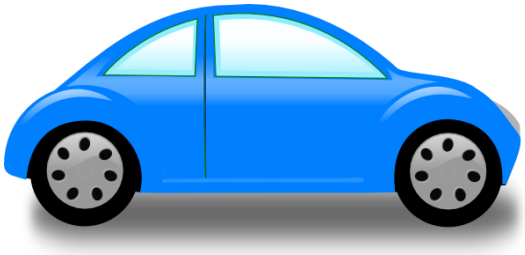
Interest in modeling the adoption of shared mobility and the use of other travel modes, controlling for personal attitudes, adoption of technology, household, individual and built environment characteristics.

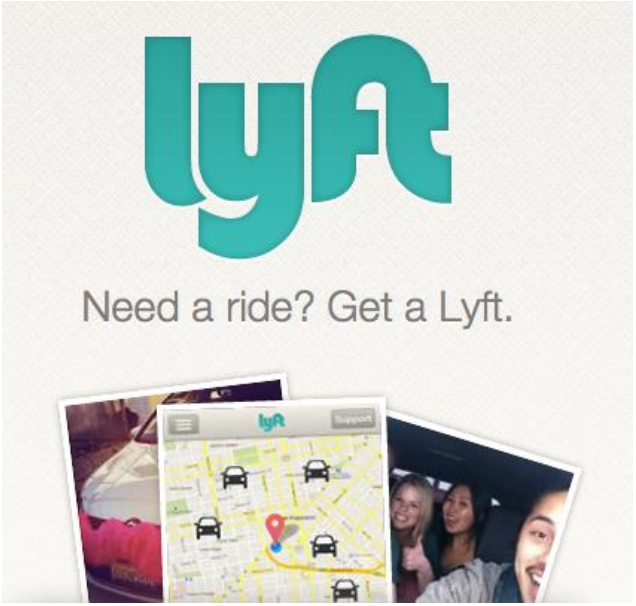
Research Questions (3)

Car Ownership vs. Shared Mobility?

Research Questions (4)

What Replaces What?



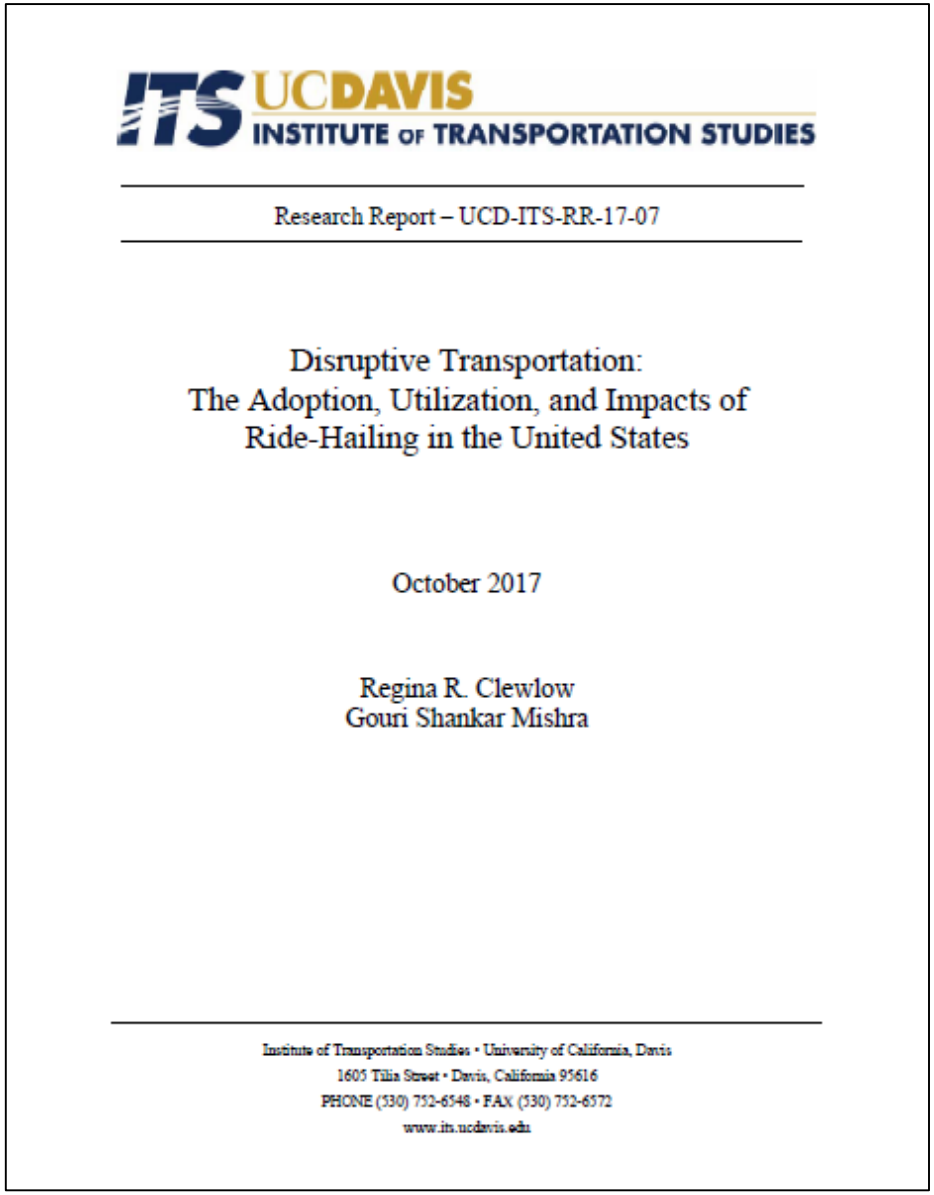


“7 Cities” study from UC Davis

Disruptive Transportation:
The Adoption, Utilization, and Impacts of Ride-Hailing in the United States
Principal Investigator: Regina Clewlow

Data from 7 U.S. Cities: Boston, Chicago, Los Angeles, New York, San Francisco Bay Area, Seattle, and Washington DC.

Focus on use of ridehailing and impacts on other components of travel behavior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Research Report – UCD-ITS-RR-17-07

Disruptive Transportation:
The Adoption, Utilization, and Impacts of
Ride-Hailing in the United States

October 2017

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Gouri Shankar Mishra

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PANEL STUDY OF EMERGING TRANSPORTATION TRENDS IN CALIFORNIA

Panel Study of Emerging Transportation Trends

- Statewide study of emerging transportation trends in California
- Design of a detailed survey to collect information on several groups of variables
- First survey administered with an online opinion panel among Millennials (18-34) and Generation X (35-50) in fall 2015
- Quota sampling by geographic region and neighborhood type
- Part of a longitudinal study (with rotating panel)

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An Institute of Transportation Studies Program

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- Susan Handy
- Pat Mokhtarian
- Lew Fulton
- Farzad Alemi
- Rosaria Berliner
- Kate Tiedeman
- Yongsung Lee
- Ali Etezady
- Grant Matson

Survey Content – First Wave (2015)

A. *Individual Attitudes and Preferences (general, environmental, technology, lifestyles, etc.)*
B. *Online Social Media and Adoption of Technology*
C. *Residential Location and Living Arrangements*
D. *Employment and Work/Study Activities*
E. *Transportation Mode Perceptions*
F. *Current Travel Behavior*
G. *Shared Mobility Services (e.g. car-sharing, Uber/Lyft, etc.)*
H. *Driver's License and Vehicle Ownership*
I. *Previous Travel Behavior and Residential Location*
J. *Aspirations for/Opinions about Future Mobility*
K. *Sociodemographic Traits*

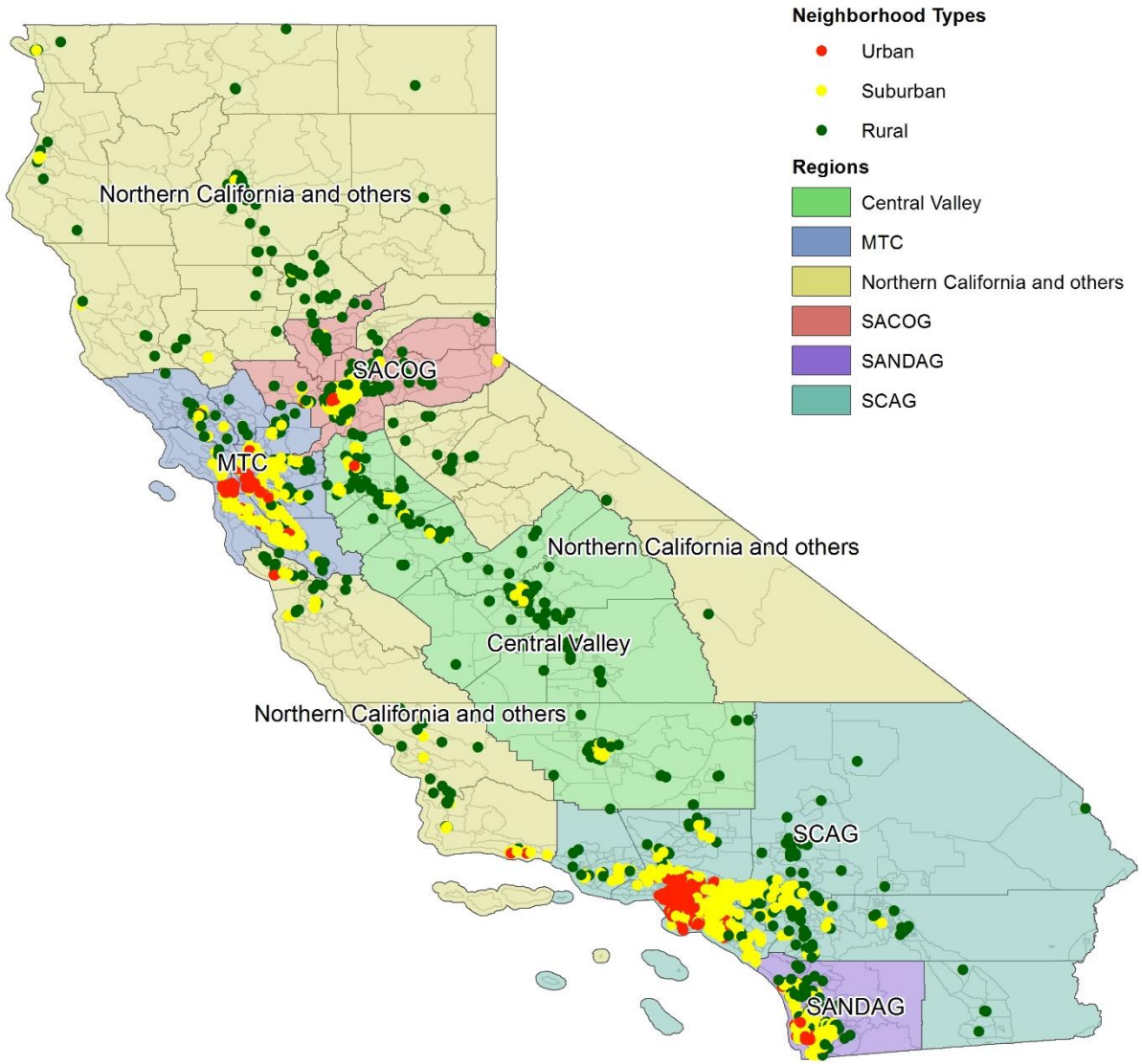
Focus on Emerging Technologies

- Smartphones (GPS, access to more info)
- Increased opportunities to multitask
- Ridehailing / shared mobility
- Lower levels of car ownership
- Extended range of public transportation

Shared Mobility Services

Type of Services	Ownership and Operational Models
Carsharing	• Fleet-based, peer-to-peer, or community based • Round trip or one way
Bikesharing	• Fleet-based or peer-to-peer • Dock-based or GPS-based
Dynamic Ridesharing	• Private-public partnership • Carpooling, vanpooling, and dynamic ridesharing
Ridehailing	• Private (may be subsidized by public in future) • Uber X and Lyft; UberPOOL and Lyft Line

The Dataset



All cases were geocoded based on residential location.

We integrated data from other sources, e.g. US Census, US EPA Smart Location Data, AllTransit, Walkscore.com, etc.

We classified the NH type as ***urban***, ***suburban*** or ***rural***, based on land use features at the census tract.

MILLENNIALS DRIVE LESS BUT DIFFERENCES IN VMT LARGELY EXPLAINED BY STAGE IN LIFE

VMT

-15%

HIGHER ADOPTION OF RIDEHAILING AMONG WELL-EDUCATED URBAN MILLENNIALS

MOST PEOPLE COMMUTE BY CAR IN CALIFORNIA. STILL, MILLENNIALS SLIGHTLY MORE LIKELY TO ADOPT OTHER MODES

MILLENNIALS WITH CHILDREN USE PUBLIC TRANSIT MORE THAN OLDER ADULTS WITH CHILDREN. SMARTPHONE USE CORRELATED WITH TRANSIT USE

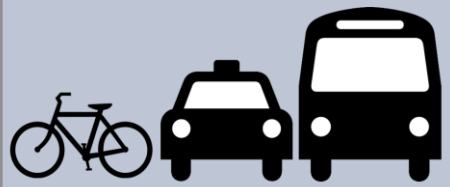
INDEPENDENT MILLENNIALS CHOOSE MORE CENTRAL, ACCESSIBLE LOCATIONS AND ARE MORE MULTIMODAL

LATENT-CLASS ANALYSIS IDENTIFIES FIVE WELL-DEFINED GROUPS OF TRAVELERS

HABITUAL DRIVERS:

84.7%

MANY UBER TRIPS MADE BY MILLENNIALS REDUCE THE AMOUNT OF WALKING AND CYCLING



HIGHER LEVEL OF SATISFACTION WITH TRAVEL AMONG NON-URBAN MILLENNIALS, THOSE THAT RIDE A BIKE AND HAVE ACCESS TO A CAR

What Affects Millennials' Mobility?
PART I: Investigating the Environmental Concerns, Lifestyles, Mobility-Related Attitudes and Adoption of Technology of Young Adults in California

May 2016

A Research Report from the National Center for Sustainable Transportation

Dr. Giovanni Circella, University of California, Davis
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ITS UCDAVIS INSTITUTE OF TRANSPORTATION STUDIES

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March 2017

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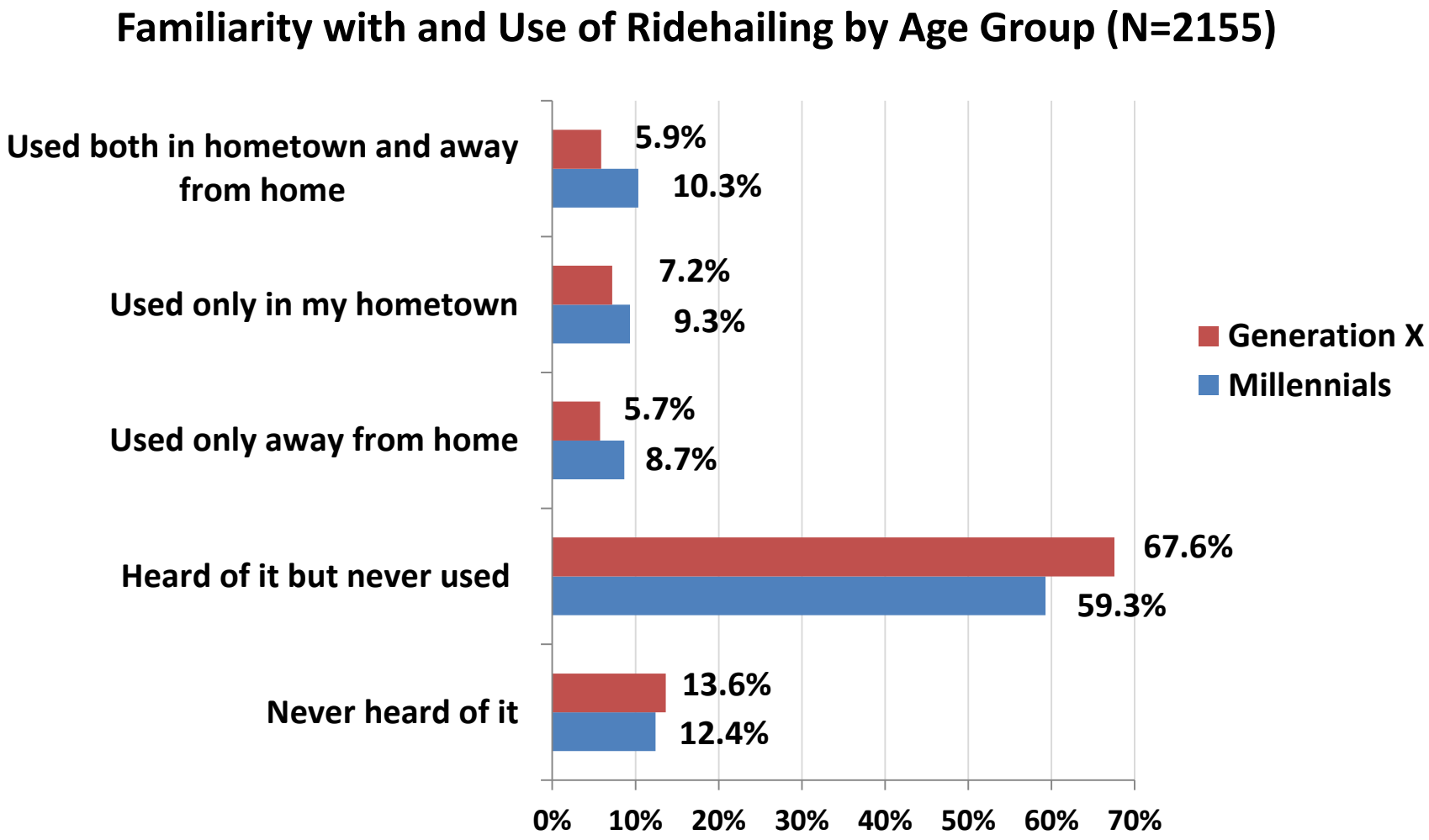
Part I and Part II Reports Available at:

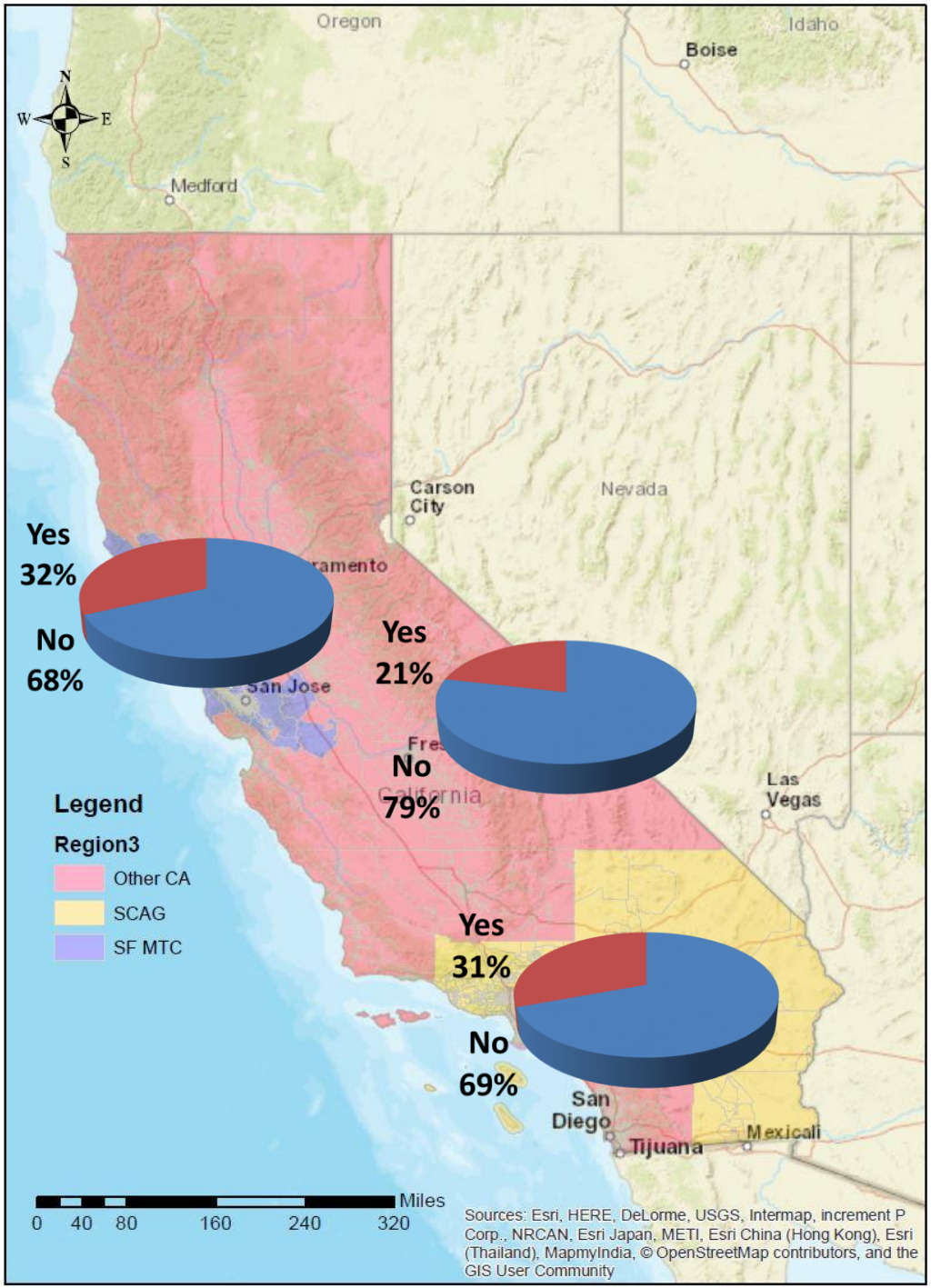
ncst.ucdavis.edu

ADOPTION OF RIDEHAILING

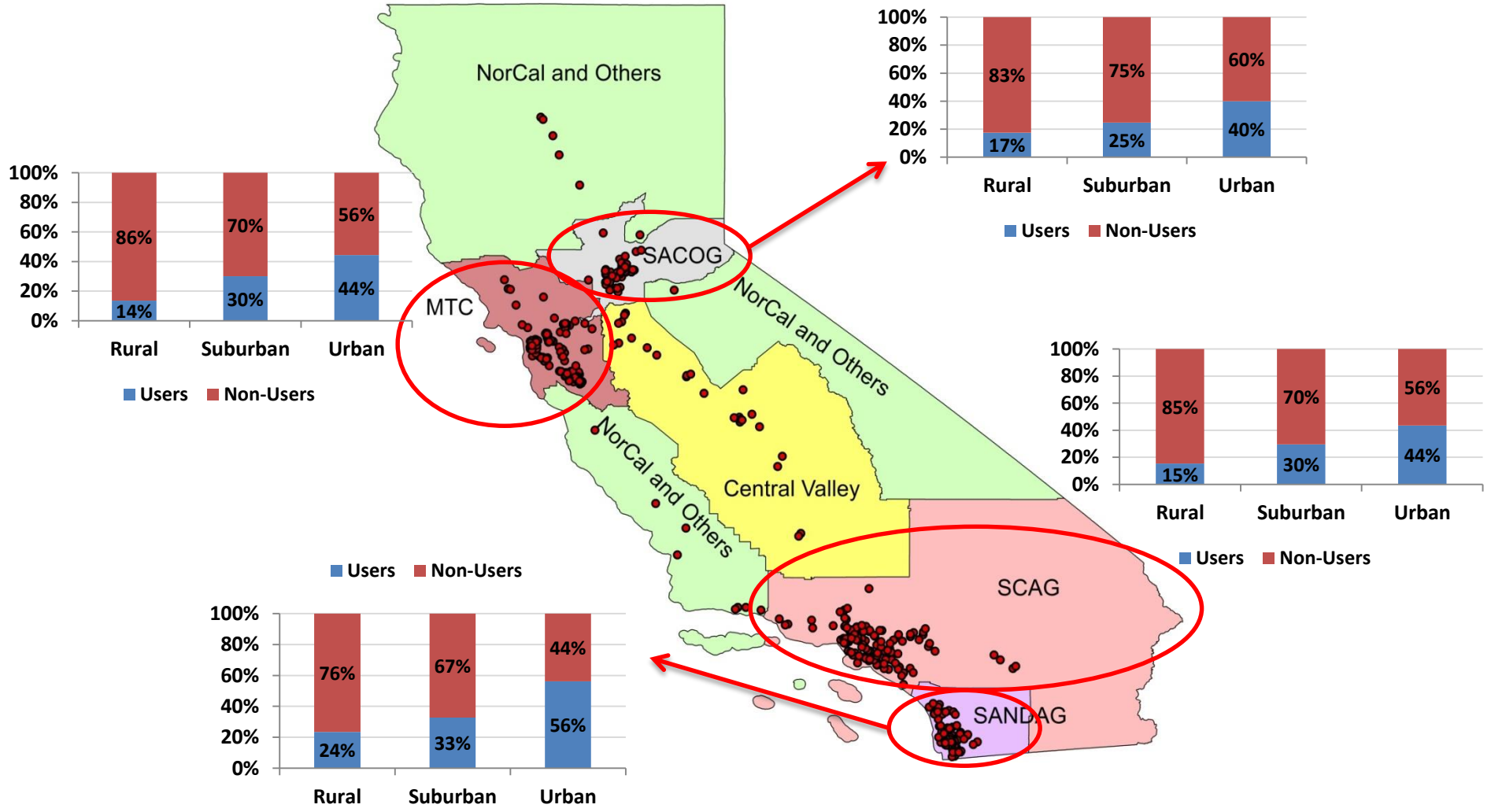
Adoption of Ridehailing



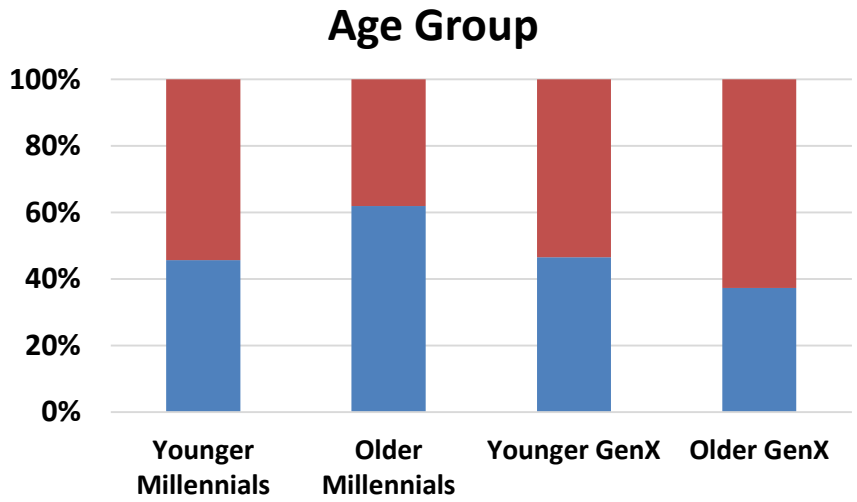
Use of Uber/Lyft

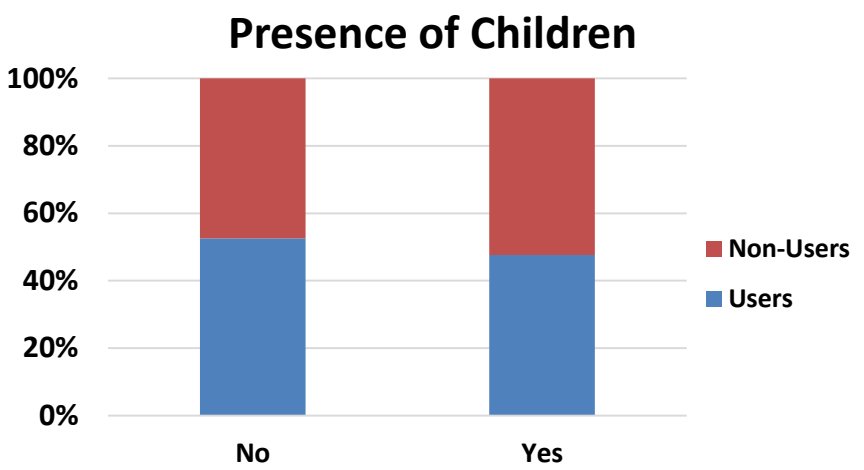


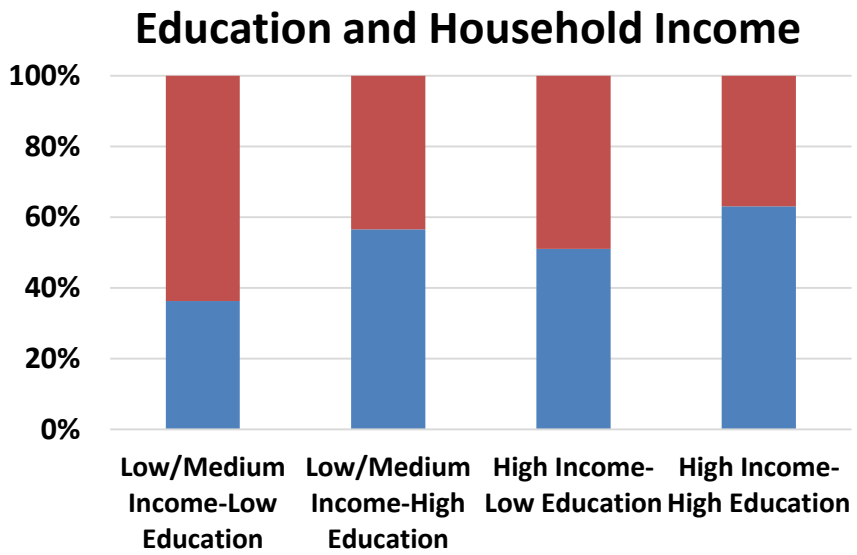
Adoption of Ridehailing (2)

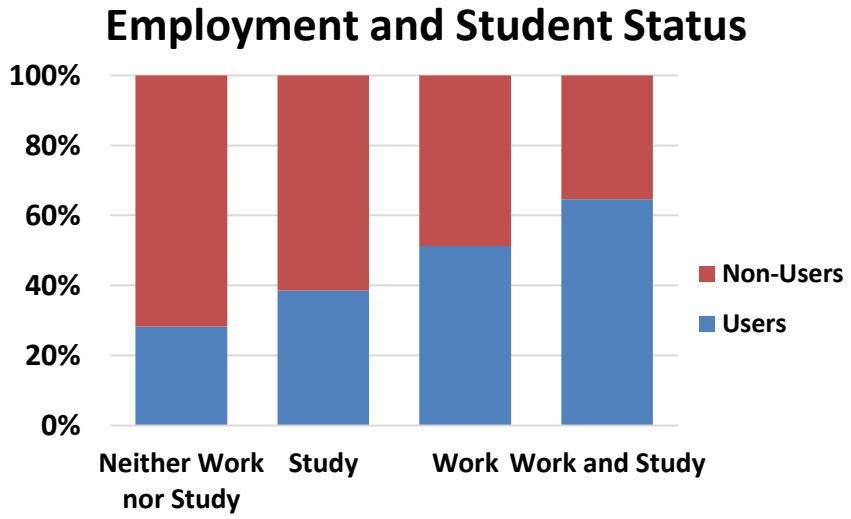


Adoption of Ridehailing (3)



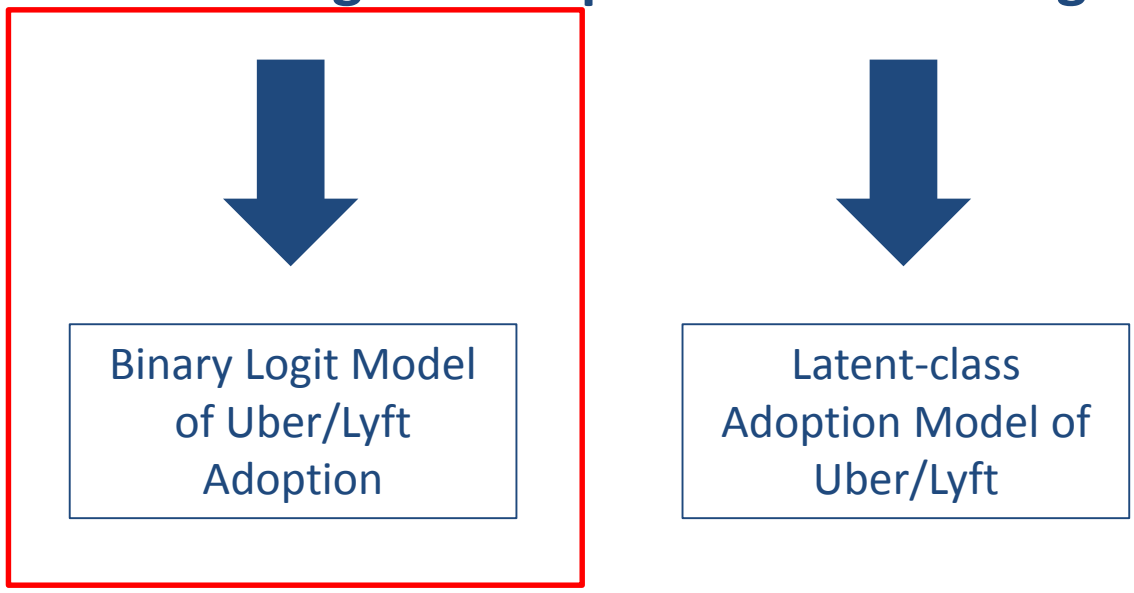






Adoption of Ridehailing (4)

Modeling the adoption of ridehailing



Investigate the impact of various factors:

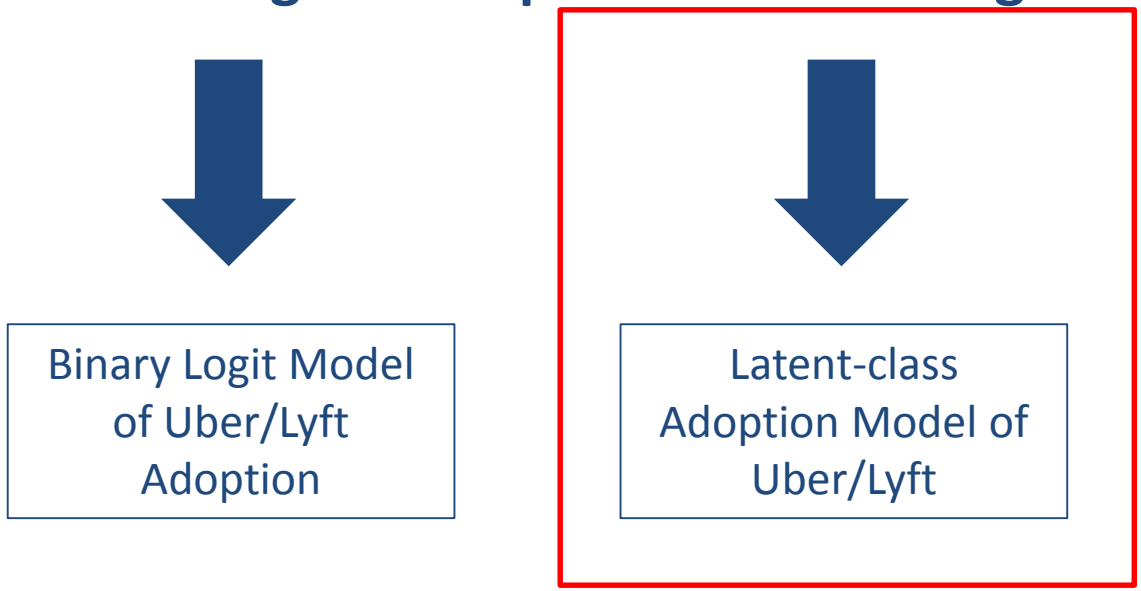
- Socio-demographics
- Built Environment
- Individuals Lifestyles
- Personal Attitudes

Results: Adoption of Lyft/Uber – Binary Model

- ***Age*** and ***income/education*** have the largest effects among sociodemographics.
- ***Car accessibility*** and ***land-use mix*** positively affect the use of ridehailing.
- Familiarity with ***ICT*** and use of ***other emerging transportation*** services are associated with higher adoption.
- Individuals with stronger ***variety- seeking, technology-embracing***, and ***pro-environment*** attitudes are more likely to use Uber/Lyft.

Adoption of Ridehailing (5)

Modeling the adoption of ridehailing



Investigate the impact of various factors:

- Socio-demographics
- Built Environment
- Individuals Lifestyles
- Personal Attitudes

Attributes of Latent Classes

- Class Size: 37%
- Highest Adoption Rate (47%)
- Independent Millennials
- Not Married
- No Kids
- Work and Study
- City Dwellers

- Class Size: 33%
- Adoption rate: 27%
- Most Affluent
- Dependent Millennials and Older Gen Xers
- Work or Study
- Live with Kid(s)

- Class Size: 30%
- Lowest Adoption Rate (%5)
- Lowest Education
- Least Affluent
- Younger Gen Xers
- Not Work nor Study
- Rural Dwellers

Results: Latent Class Adoption Model

Adoption Rate: 47%

- *Higher-educated independent millennials* who live *in more central areas* and in households *without kids*
- The adoption rate significantly increases as the *rates of technology adoption* and *frequency of long-distance leisure travel by plane* increase.

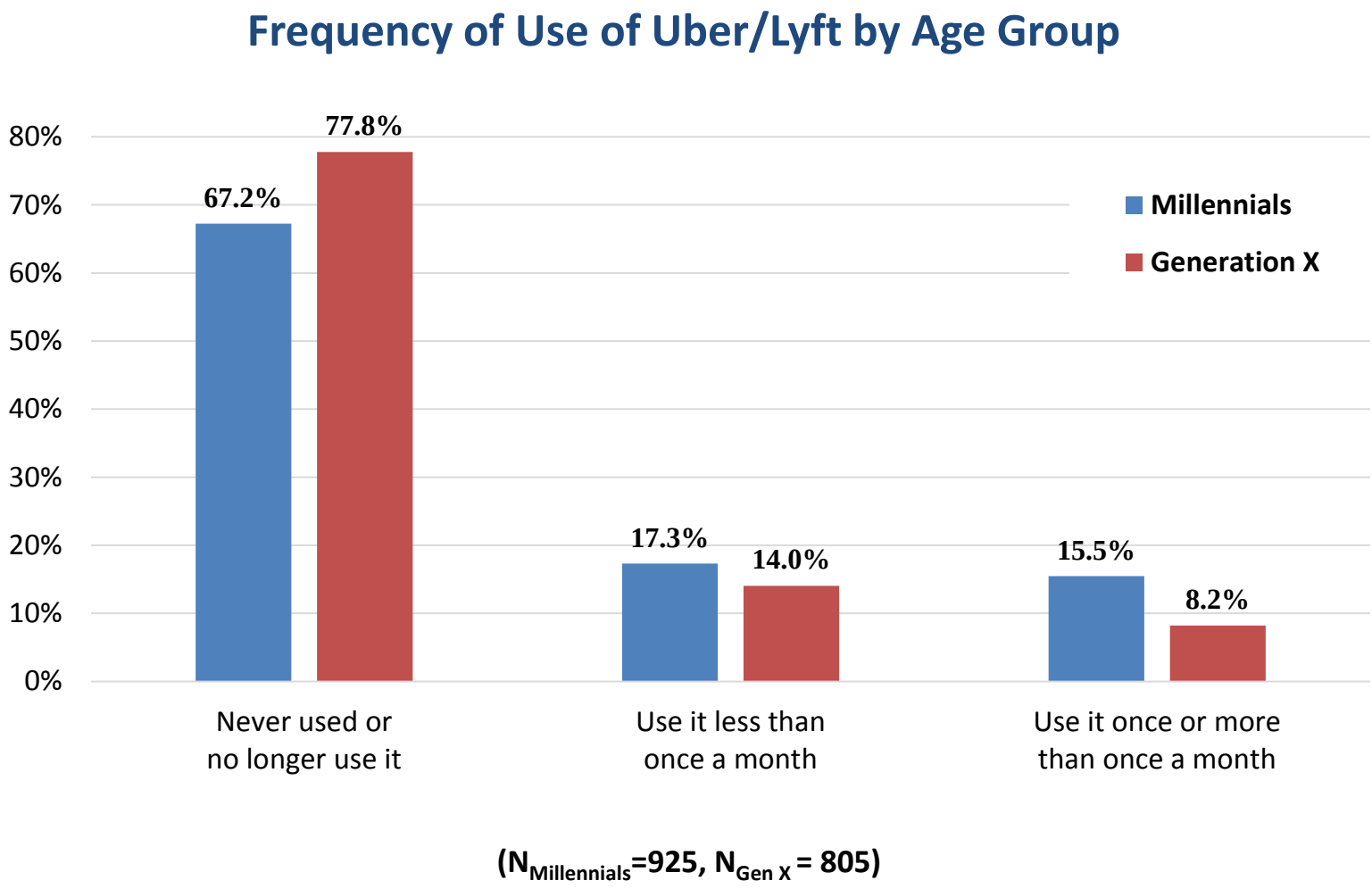
Adoption Rate: 27%

- *Most affluent* individuals, predominantly *dependent millennials* or *older Gen Xers,* who live with their *families*.
- Technology adoption rate, household income, and frequency of non-car business long-distance trips affect the adoption.

Adoption Rate: 5%

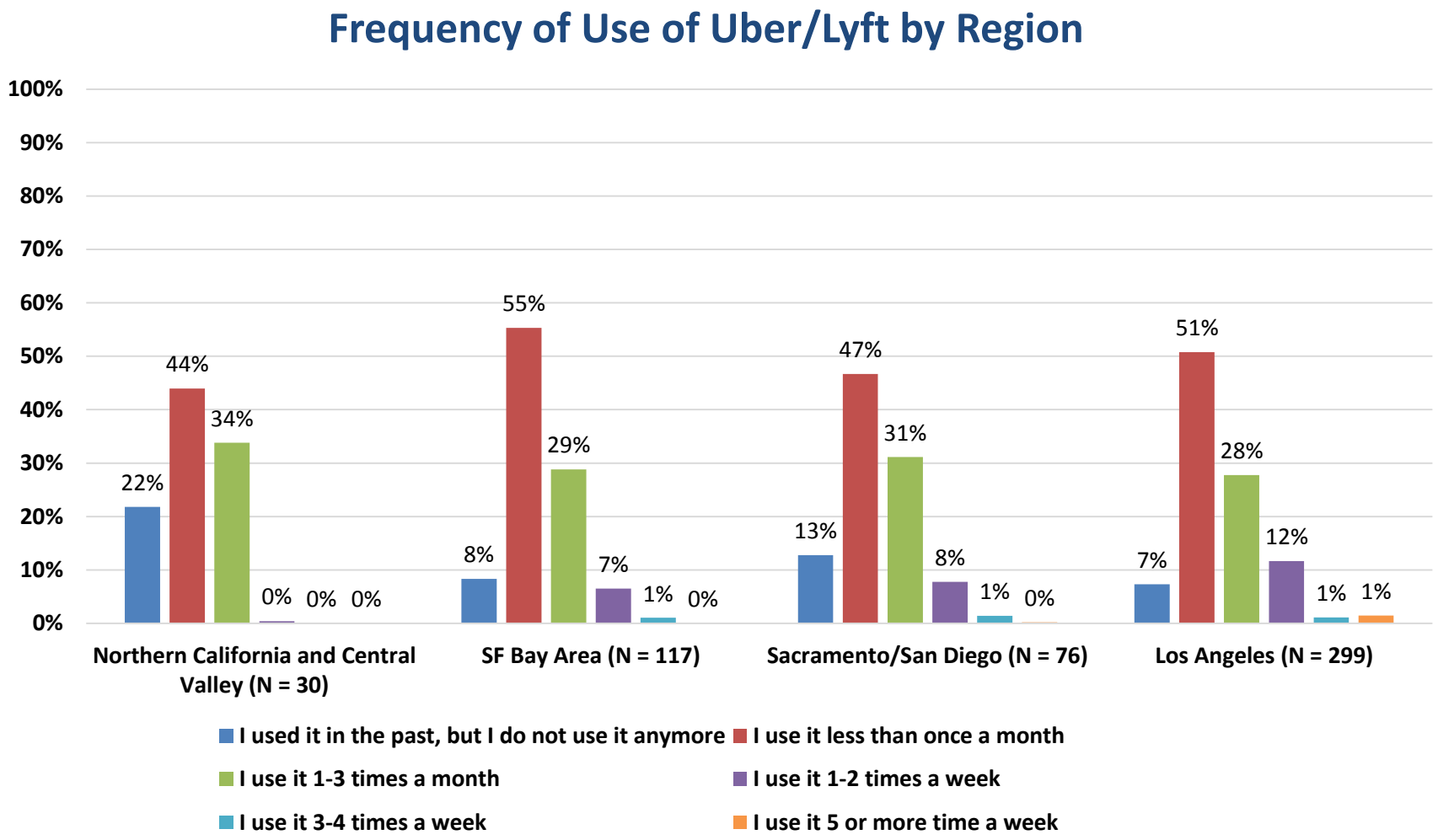
- *least affluent* and *less educated* individuals, who live in *rural* neighborhoods and *do not work nor study*.
- Adoption rate is affected by the characteristics of the *built environment*, including *transit accessibility* and *land-use mix*.

Frequency of Use of Ridehailing



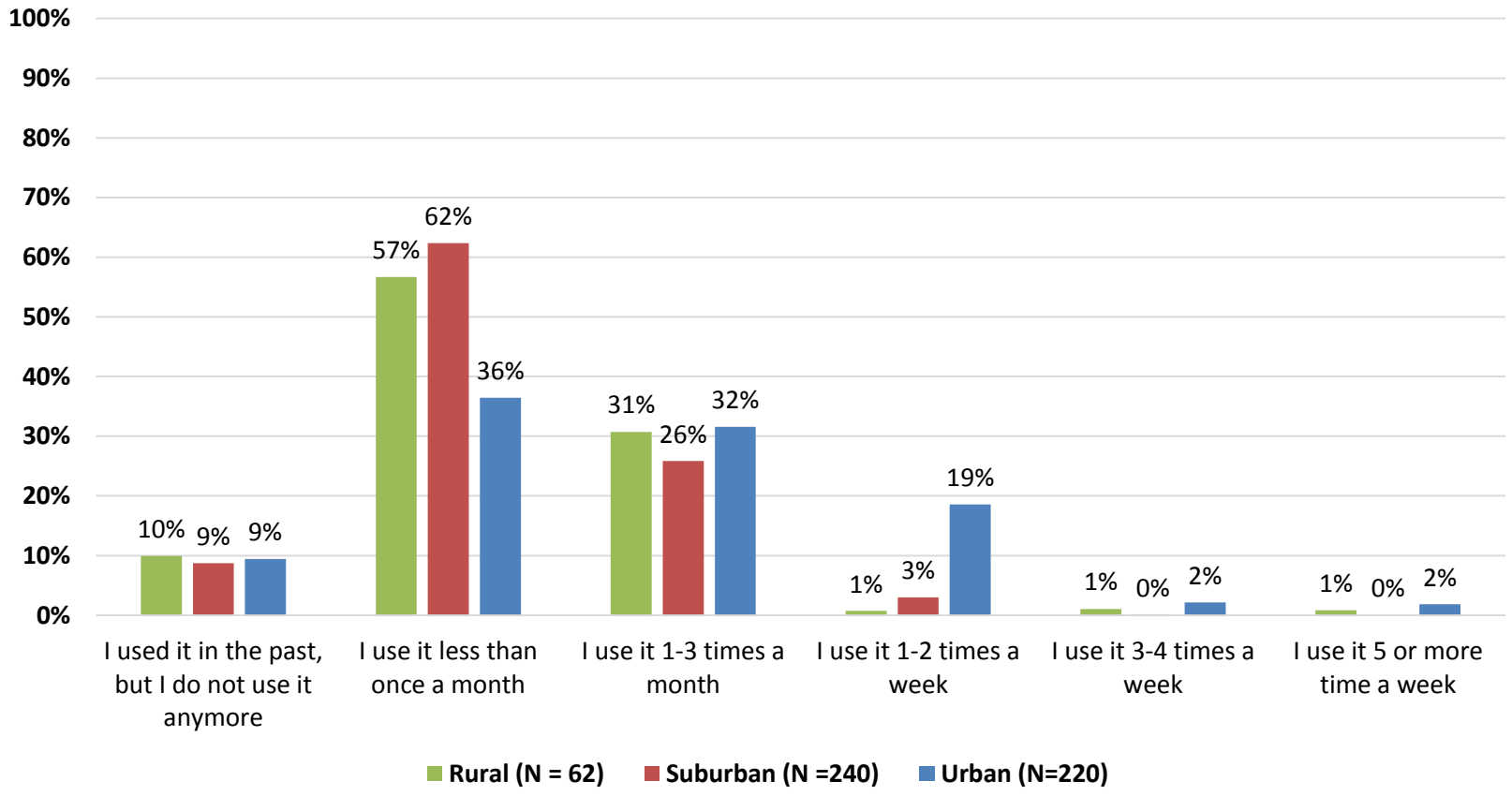
($N_{Millennials}$=925, $N_{Gen\ X}$ = 805)

Frequency of Use of Ridehailing (2)



Frequency of Use of Ridehailing (3)

Frequency of Use of Uber/Lyft by Neighborhood Type



Frequency of Use of Ridehailing (4)

Modeling the frequency of use of ridehailing:

- Users only answered the frequency question.
- Exclusion of non-user would artificially inflate the coefficients associated with the exogenous variables.
- To account for selectivity and/or inflation we used:
  - ✓ Ordered Probit with Sample Selection (OPSS)
  - ✓ Zero-inflated Ordered Probit (ZIOP)

Results: Frequency Model of Ridehailing Use

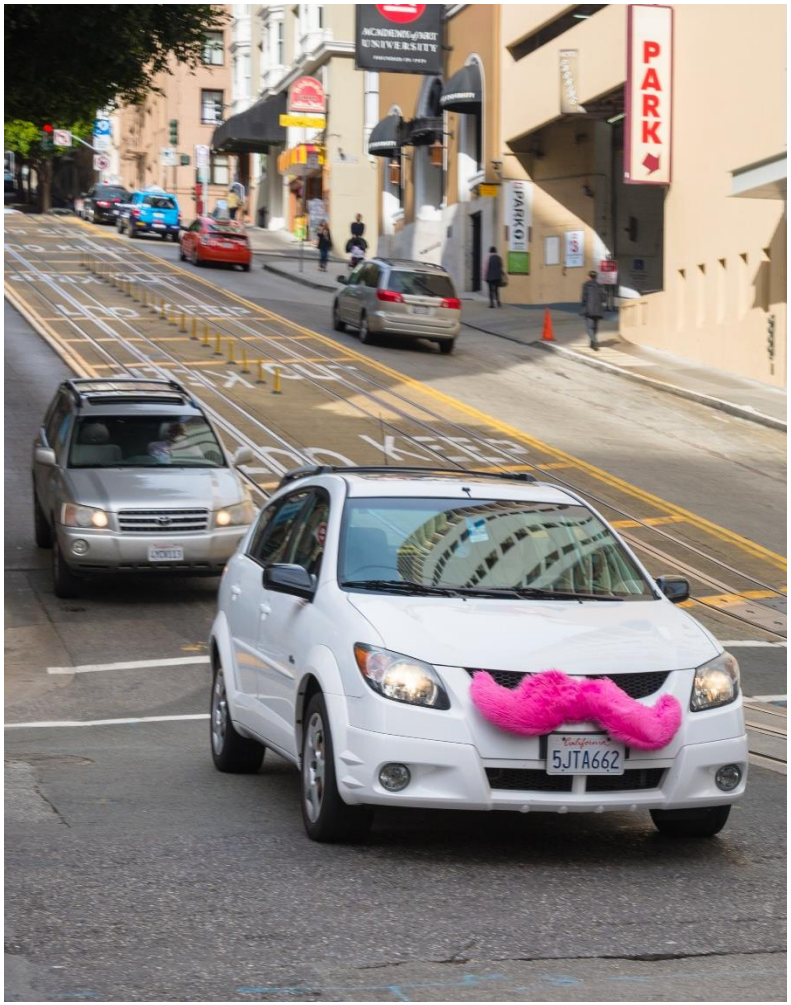


Photo credit: Sergio Ruiz

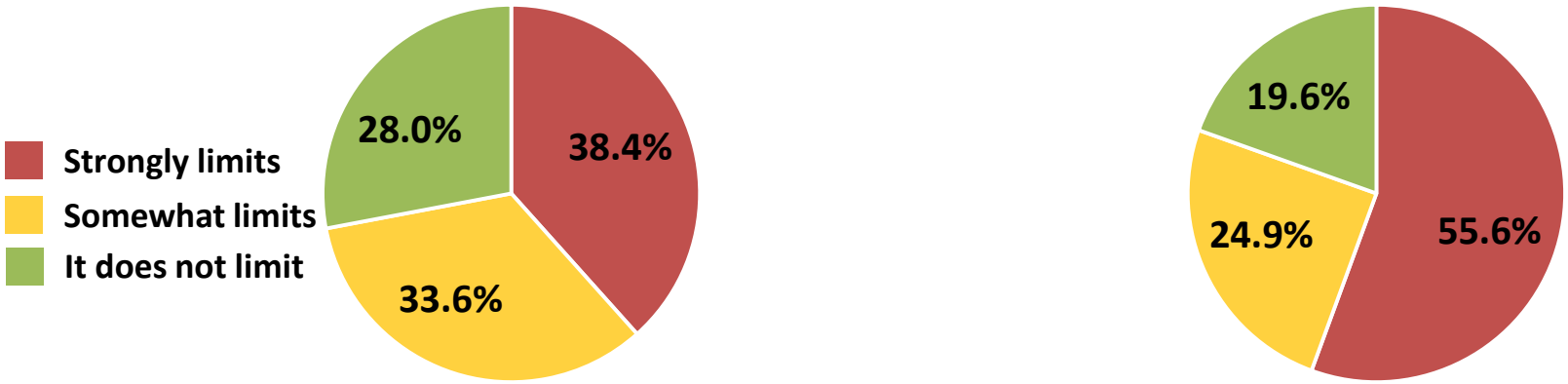
- ***Sociodemographics*** are good predictors of adoption but not so much of frequency.
- Individuals who live in a ***zero-vehicle household*** use Uber/Lyft more frequently.
- Frequent ***long-distance travelers*** (by plane, in particular) use Uber/Lyft more often.
- ***Land-use mix*** and ***population+job density*** impact the frequency of use of ridehailing.
- Those that prefer to own/use their ***own vehicle*** less likely to be frequent users.
- Competition with other shared-mobility services:
  - The higher the frequency of ***carsharing*** use, the lower the frequency for Uber/Lyft.

LIMITATIONS AND IMPACTS ON OTHER TRAVEL MODES

Limitations to the Use of Ridehailing

Have used Uber/Lyft before ***Have not used Uber/Lyft before***

Prefer to have/use my own vehicle

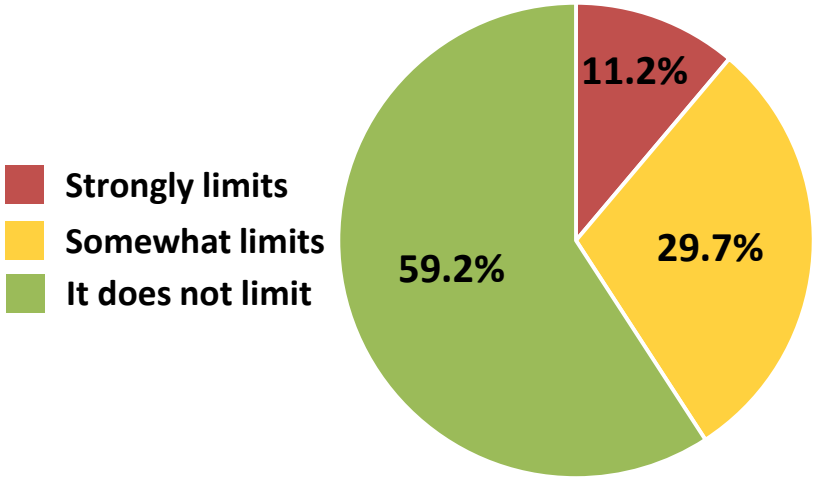


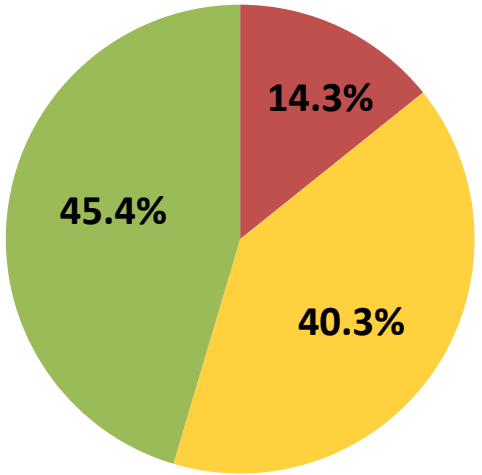
Concern about safety/comfort

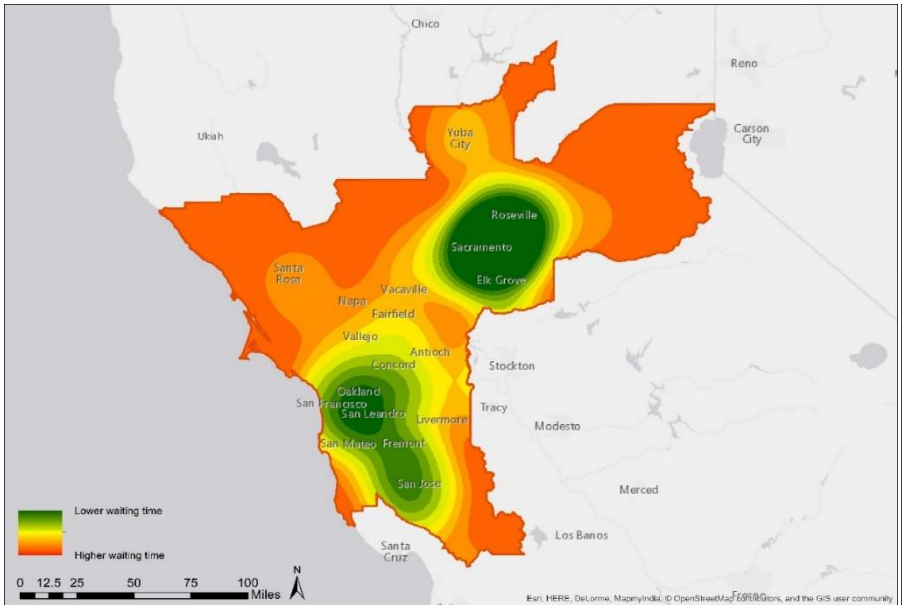
Limitations to the Use of Ridehailing (2)

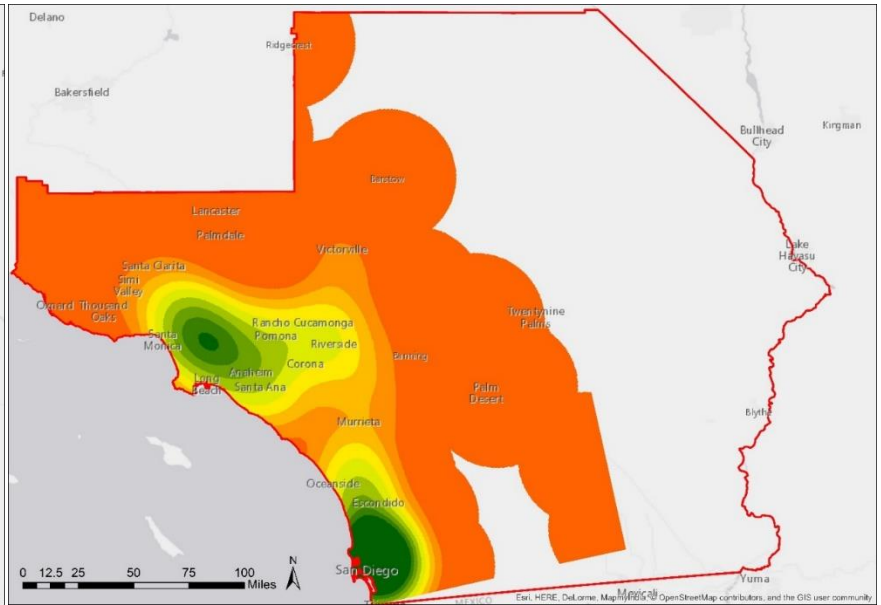
Have used Uber/Lyft before ***Have not used Uber/Lyft before***

Waiting time when I need to use the service



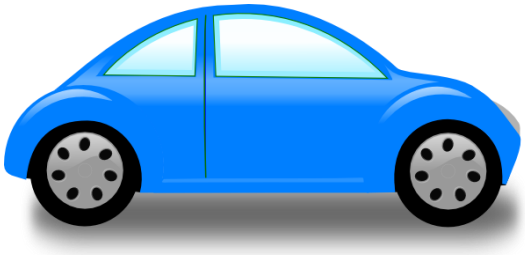


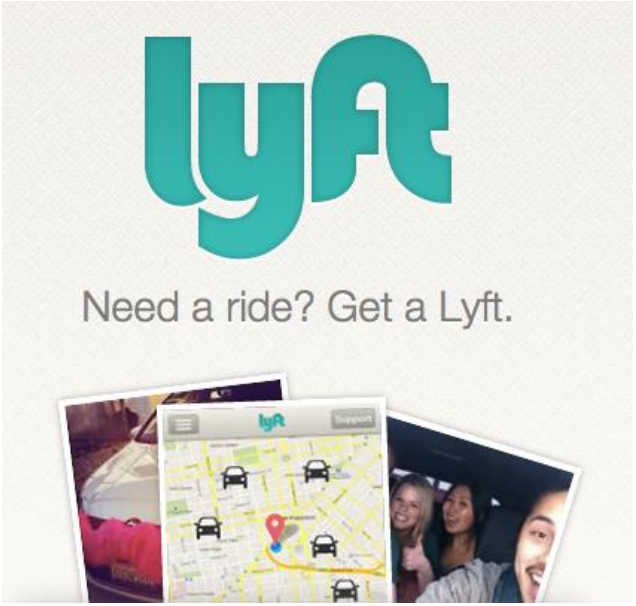




Research Question

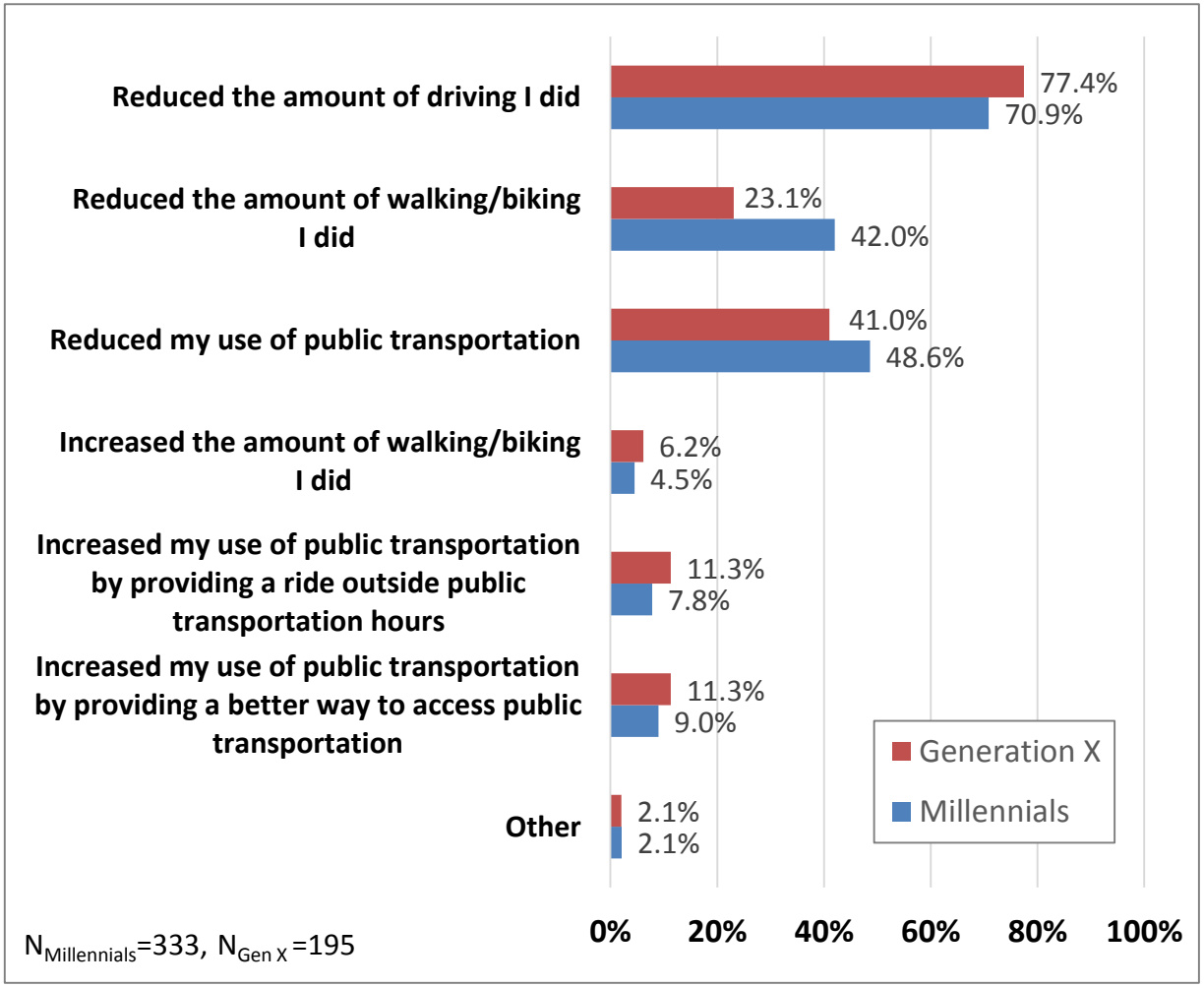
What Replaces What?





Impacts on the Use of Other Travel Modes

Impact of last Lyft/Uber trip on the use of other means of transportation (by age group)



Impacts on the Use of Other Travel Modes (2)

Latent Class Analysis

Identification of different classes of behavioral changes

- Urban dwellers
- Walkable neighborhoods with good transit access
- Cost and time sensitive
- Least affluent
- Younger/independent Millennials
- Frequent commuters
- Multimodal travelers
- Most frequent users of Uber/Lyft

Class 1 (size=53%)

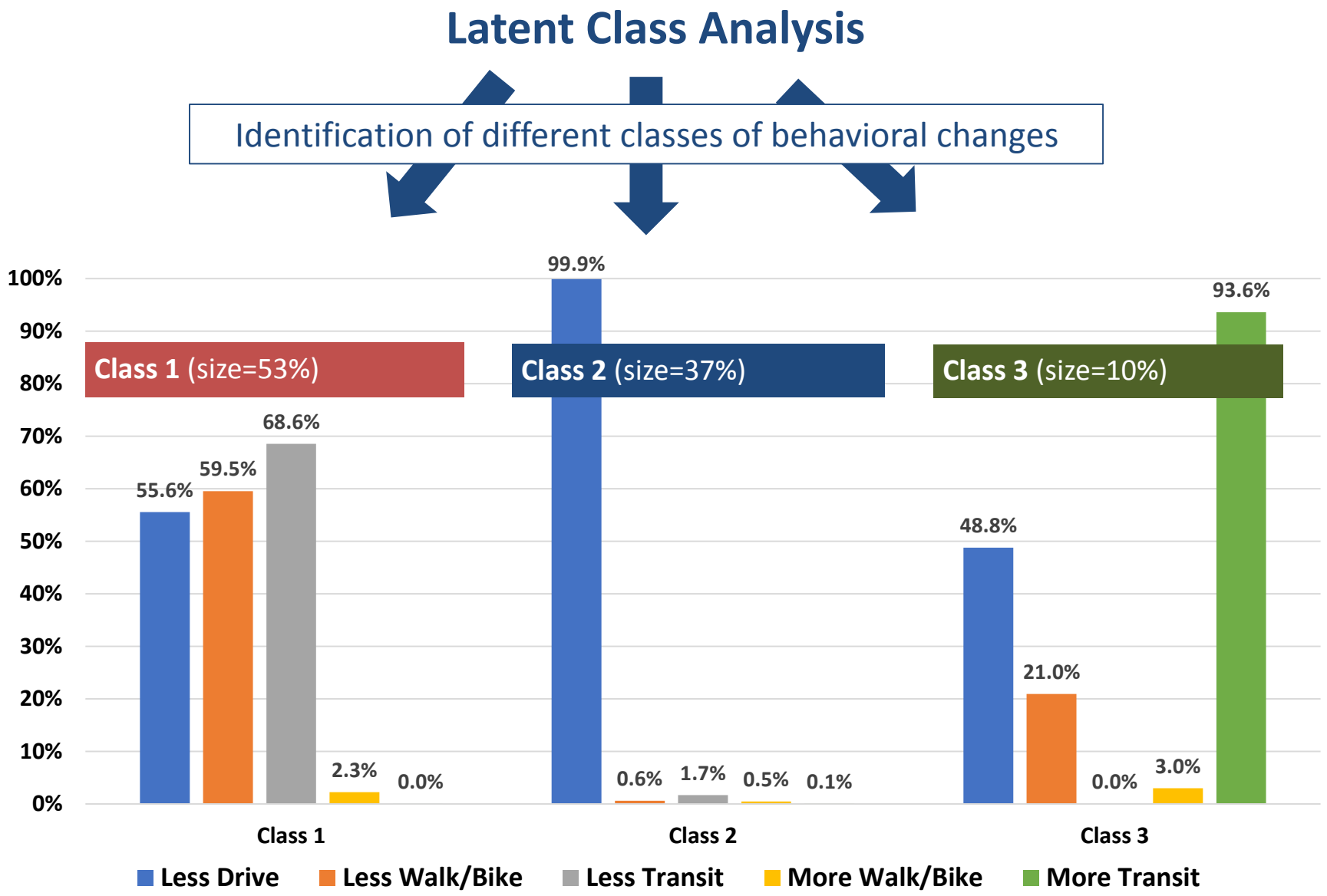
- Suburban Dwellers
- Car-oriented neighborhoods with poor transit access
- High number of vehicles per household drivers
- Frequent commuters
- Monomodal with high VMT
- Pro-suburban
- Materialistic/must own car
- Frequent air travelers
- Medium Uber/Lyft frequency

Class 2 (size=37%)

- Suburban Dwellers
- Low transit and walk accessibility
- Not cost and time sensitive
- Older Gen Xers
- Want to come back to urban area
- Non-frequent commuters
- Multimodal when possible
- Like biking
- Pro-environment
- Low frequency users

Class 3 (size=10%)

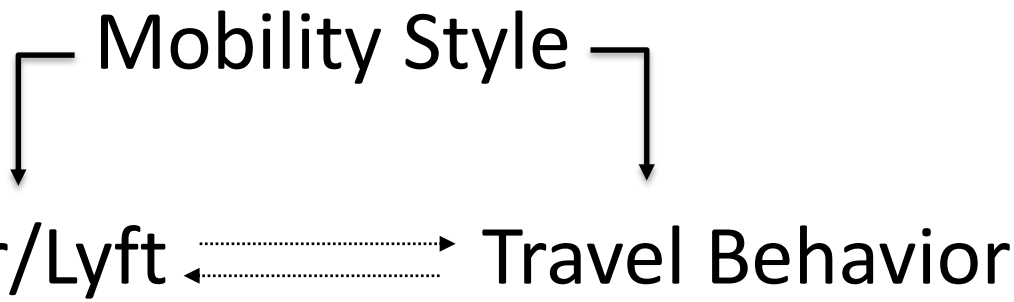
Impacts on the Use of Other Travel Modes (2)



Research Question

How does the adoption of *shared mobility* affect other components of *travel behavior (e.g. use of public transit)*?

Jointly model the adoption of shared mobility and *use of other modes*:



Modeling approaches: *bivariate ordered Probit*, *recursive Probit*, or *latent-class structural equation models**:

- Results show positive correlation between the frequency of use of ridehailing and of public transit (this does ***not*** imply causality)

**Latent-class SEM to be developed in later stages of the research*

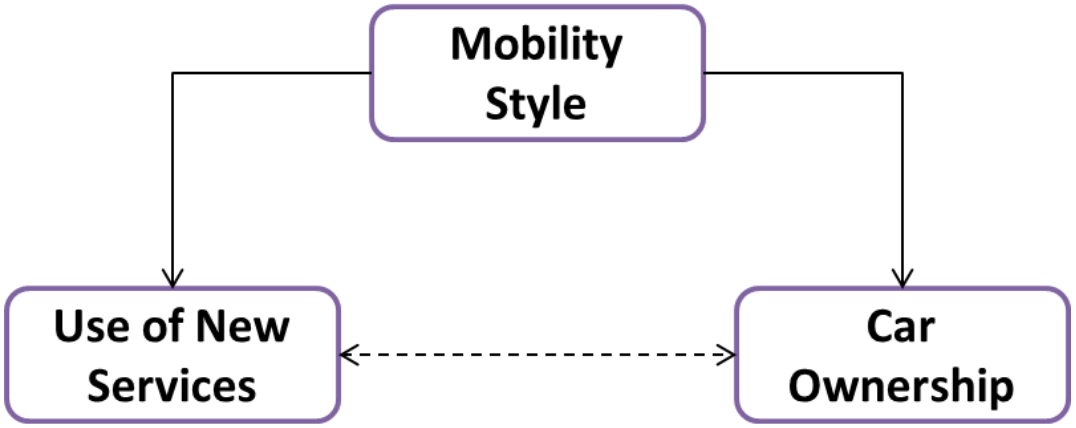
Research Question

Car Ownership vs. Shared Mobility?

Longitudinal Analysis of Vehicle Ownership Trends

How does the adoption of *shared mobility* affect other components of *travel behavior* and *vehicle ownership*?

Jointly model the adoption of shared mobility and *use of other modes* or *vehicle ownership*:



Data from longitudinal component of panel study (2015-2018) will help disentangle the relationship with *vehicle ownership*…

Policy Implications and Research Needs

- Cost and personal-vehicle preference are limiting factors to the use of ridehailing → **Pooling is the answer!**
  - Pooling is the primary strategy to reduce prices and negative externalities.
  - It is a case where the public interest aligns with business interests.
  - Policymakers need better understanding of who might use pooling services and what incentives and policies could encourage them to do so.
  - More research is needed to determine price elasticity among different travelers.

- Single-passenger ridehailing tends to *(a)* substitute for driving, *(b)* replace the use of transit or active modes (especially among some groups), and *(c)* increases the attractiveness of living without a car:
  - Opportunities for demand-responsive services and microtransit.
  - Shared mobility can be integrated with public transit to provide better overall service, with lower economic and environmental costs.
  - More research is required to better understand the true nature and the causality links between the use of Uber/Lyft and the use of other modes.

Policy Implications and Research Needs (2)

- Need to better coordinate policy making and incentives in order to harvest the potential benefits of these services while reducing the negative effects.

- More studies are needed to help researchers and professionals understand the on-going transportation transformation and guide it to a better future:
  - In future research, we plan to apply more nuanced analytical approaches to investigate behavioral changes in disaggregated way.
  - The availability of longitudinal data will allow studying travel patterns over time and disentangle the causality among the adoption of these services, travel behavior and changes in vehicle ownership.
  - Even more important in a future dominated by driverless vehicles!

Scientific Papers and Presentations

- Circella, G. F. Alemi, R. Berliner, K. Tiedeman, Y. Lee, L. Fulton, S. Handy and P. Mokhtarian "Multimodal Behavior of Millennials: Exploring Differences in Travel Choices Between Young Adults and Gen-Xers in California", Presented at the Transportation Research Board 96th Annual Meeting, Washington DC, January 2017, *TRB Paper #17-06827*.
- Tiedeman, K., G. Circella, F. Alemi and R. Berliner "What Drives Millennials: Comparison of Vehicle Miles Traveled Between Millennials and Generation X in California", Presented at the Transportation Research Board 96th Annual Meeting, Washington DC, January 2017, *TRB Paper #17-06044*.
- Berliner, R. and G. Circella "Californian Millennials Drive Smaller Cars: Estimating Vehicle Type Choice of Millennials", Presented at the Transportation Research Board 96th Annual Meeting, Washington DC, January 2017, *TRB Paper #17-06744*.
- Alemi, F., G. Circella, S. Handy and P. Mokhtarian. Under review. "What Influences Travelers to Use Uber? Exploring the Factors Affecting the Adoption of On-Demand Ride Services", Presented at the Transportation Research Board 96th Annual Meeting, Washington DC, January 2017, Paper No. 17-05630; Submitted to Travel Behavior and Society (2017).
- Alemi, F., G. Circella and S. Handy. Under review. "Exploring the Latent Constructs behind the Use of On-Demand Ride Services in California". Submitted for publication in the Journal of Choice Modelling.
- Alemi, F., G. Circella, and D. Sperling. Forthcoming. "On-demand Ride Services in California: Investigating the Factors Affecting the Frequency of Use of Uber/Lyft", To be presented at the Transportation Research Board 97th Annual Meeting, Washington DC, January 2018.
- Circella, G., F. Alemi and P. Mokhtarian. "Exploring the Impact of Shared Mobility on California Millennials and Older Adults' Travel Patterns", Presented at the 2017 International Choice Modeling Conference, Cape Town (South Africa), April 2017.

Papers presented at international conferences:

- Transportation Research Board 2017: 4 papers
- International Choice Modeling Conference 2017: 2 papers
- Association of Collegiate Schools of Planning 2017: 2 papers
- Transportation Research Board 2018: 6 papers

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Exploring the Latent Construct

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Adoption of Uber and Lyft, Factors Limiting and/or Encouraging Their Use and Impacts on Other Travel Modes among Millennials and Gen Xers in California

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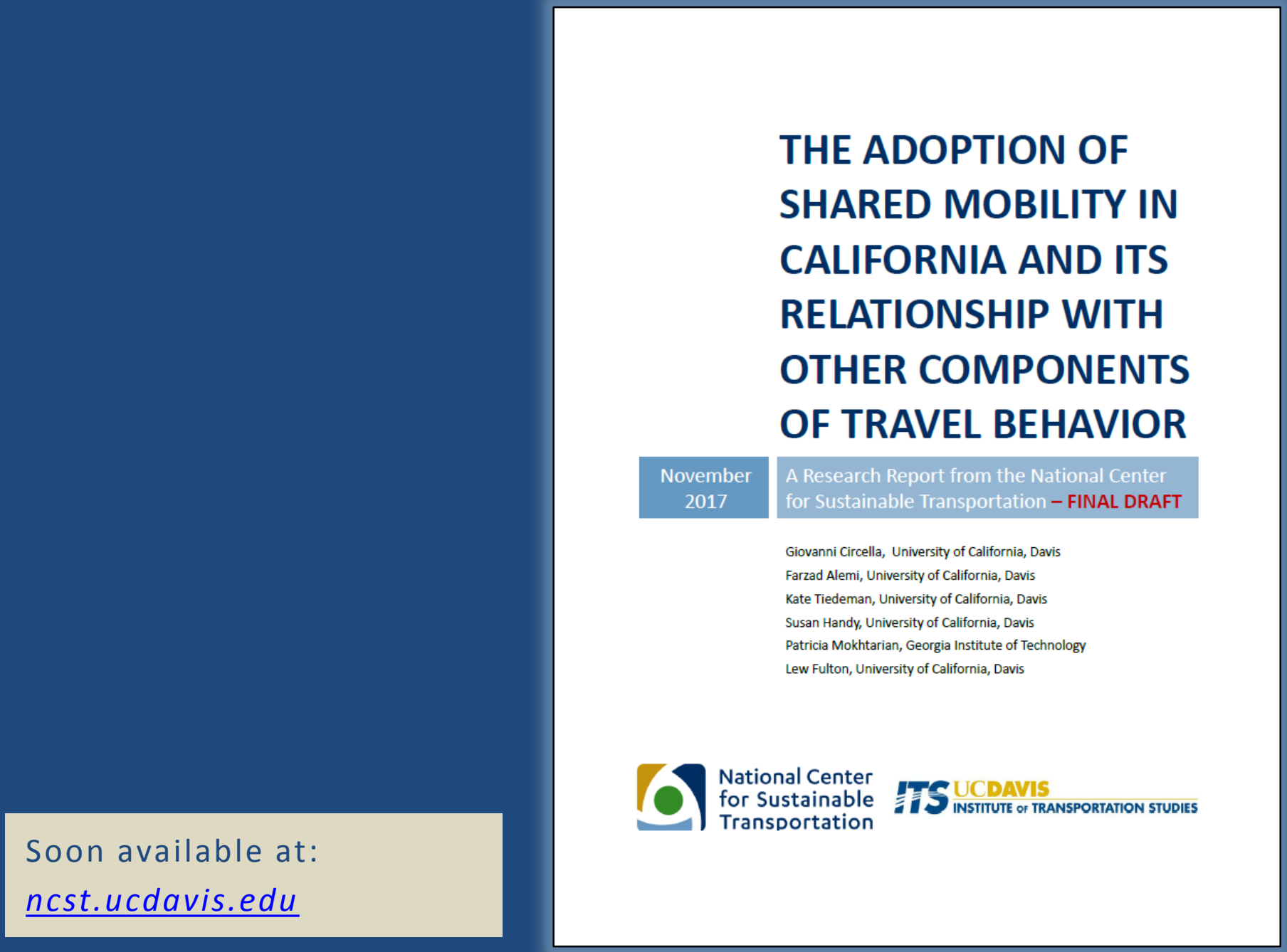

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